comp.periphs.scsi FAQ part 1 of 2

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                      SCSI FAQ:
           Frequently Asked Questions for comp.periphs.scsi

FAQ history:    Created by Johnathan Vail (vail@prepress.pps.com) from articles
                submitted to him by comp.periph.scsi readers.
                Maintained by Johnathan Vail until November 1993.

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                Where you see reference to [Editor(GF)] that means me.

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Where to get the latest copy of this FAQ:
  The comp.periphs.scsi FAQ is posted to Usenet during the first week
  of each month. In addition, a recent version can be obtained
  via anonymous ftp from:

  ftp.ultranet.com:
      pub/gfield/scsi/scsi-faq.part*
      Note: the gfield directory will not show up using DIR, but it’s
      actually there. Just CD to it.
  OR
  rtfm.mit.edu:
      pub/usenet-by-group/comp.periphs.scsi/comp.periphs.scsi_FAQ_part_*

  via World Wide Web (WWW):
  http://www.cis.ohio-state.edu/hypertext/faq/usenet/scsi-faq/
  OR
  http://www.paranoia.com/~filipg/HTML/LINK/F_SCSI.html
  OR
  http://www.ultranet.com/~gfield/scsi/scsi-faq.part1.txtand ...part2.txt

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====
QUESTION: What is SCSI?
ANSWER From: LSD, L.J.Sak@Kub. Edited by Gary Field(gfield@grcelect.ultranet.com)
====

SCSI stands for Small Computer Systems Interface. It's a standard for connecting peripherals to your computer via a standard hardware interface, which uses standard SCSI commands. The SCSI standard can be divided into SCSI (SCSI1) and SCSI2 (SCSI wide and SCSI wide and fast).
SCSI2 is the most recent version of the SCSI command specification and allows for scanners, hard disk drives, CD-ROM players, tapes [and many other devices] to connect.

====
Question: What do all these SCSI buzzwords mean?
Answer From: hennes@stack.urc.tue.nl (Hennes Passmann)[Editor(GF)]
====

-Host adapter:
The card that connect your computer to the SCSI-bus.
Usually called SCSI-controller by marketing droids.

-Terminators (passive).
A group of resistors on the physical ends of a single ended SCSI-bus (and only on these ends) that dampens reflected signals from the ends of the bus.
Each terminated signal is connected by:
* 220 Ohm to +5 volt (TERMPWR)
* 330 Ohm to ground.
The 18 signals that are terminated are:
I/O, Req, C/D, Sel, Msg, Rst, Ack, Bsy, Atn, DB(p), DB(7) ... DB(0).

-Terminators (active).
Rather than passive terminators that use TERMPWR which may not be exactly +5v, active terminators use a voltage regulator.

-Single ended:
"Normal" electrical signals. Uses open collector to the SCSI bus, [usually] survives wrong cable insertion. DIFFSENSE signal is used to detect connection of wrong type devices.
The max. length for SCSI-1 is a 6 meter cable with stubs of max 10cm allowed to connect a device to the main-cable.
Most devices are single ended.

-Differential:
Uses two wires to drive one signal.
Max. cable length of 25 meters.
Electrically incompatible with single ended devices!
SCSI-1 and upwards.

-Apple kludge:
The single ended 50 pins cable has been reduced to 25 pins by tying most grounds together. DB25 connector (like a parallel port).
Often used as the external SCSI connector.

-Asynchronyous SCSI:
A way of sending data over the SCSI-bus.
The initiator sends a command or data over the bus and then waits until it receives a reply (e.g. an ACKnowledge).
All commands are send asynchronously over the 8 bit part of the SCSI-bus.

-Synchronous SCSI.
Rather then waiting for an ACK, devices that both support synchronous
SCSI can send multiple bytes over the bus in the folowing way:
send data1 : send data2 : ... : send data3 (max outstanding bytes)
: wait : wait : response1 : reponse2: ...
This improves throughput, especially if you use long cables.
(The time that a signal travels from one end of the cable to the other
end of the cable IS relevant.)

-Fast SCSI:
Fast SCSI allows faster timing on the bus. (10MHz instead of 5MHz)
On a 8 bit SCSI-bus this increases the *theoretical* maximum speed
from 5MB/s to 10MB/s. I know of no single drive that reaches these speeds.

- RAID:[Added by Editor(GF)]
A Redundant Array of Independant Disks is a set of drives connected to
a special dual ported SCSI adapter that allows certain types of access
optimization. A RAID 0 array stripes the data accross multiple drives
to decrease data latency. A RAID 1 array mirrors the data on multiple drives
for increased data integrity. A RAID 5 array contains extra drives that are
used to apply ECC data correction and provide high reliability.

-Ultra SCSI:
Allows up to 20MHz signals on the bus.

-Wide SCSI:
Uses an extra cable (or 68 pin P cable) to send the data 16 or 32 bits wide.
This allows for double or quadruple speed over the SCSI-bus.
Note that no *single* drive reaches these speeds, but groups
of several drives can.

====
Question: What is the history of SCSI (What is SASI)?
Answer From: hennes@stack.urc.tue.nl (Hennes Passmann)
====

#include <stddisclaimer.h>

1979 The disk drive manufacturer Shugart begin working on a new drive
interface with logical rather then physical adressing.
It used 6 byte commands.

Shugart Associates Systems Interface (20 pages long) made public.

A few SASI drives are developed

1980 Attempt to make SASI an ANSI standard failed.

1981 Shugart and NCR request an ANSI committee be formed for SASI

1982 ANSI committee X3T9.2 is formed.
SCSI adds the ATN signal to the bus and creates the message protocol.

1983 Development of SCSI drives and ST-506 to SCSI bridges begins

1985 CCS (Common Command Set) used in most disk drives.
Only disk and tape commands were adequately specified.

1986 Work begins on SCSI-2

1986 SCSI-1 becomes official as ANSI X3.131-1986
(yes, after the work had begun on SCSI-2)
6 and 10 byte commands.
SCSI-2 specifies CDROM commands.

1988 Production of SCSI-2 devices begins

1993 Work begins on SCSI-3

1994 SCSI-2 becomes official as X3.131-1994

SCSI-2 is backwards compatible with SCSI-1 and adds the following:
*Fast SCSI-2. Optional bus speed of 10MHz instead of 5MHz.
*Wide   Optional 16 or 32 bit cable instead of 8 bits.
*more commands defined, many optional (I'm not going to type the
entire list here)
*broader support for non-disk devices (tape.CDROM,Scanners....)

SCSI-2 devices can talk to the host adaptor on their own inititive.
(e.g. to set in which mode they shoud operate, FAST or not, wide,
extra wide or normal ...) This can confuse some older SCSI-1 HA.

1995 Production of drives that have some SCSI-3 enhancements

Ultra SCSI: Bus speed of 20MHz?

1996: SCSI-3 proposals include:
-Support for graphical commands.
-Fibre channel protocol (fibre channel)
-Serial packet protocol (IEEE P1394)
-SCSI-3 general packet protocol (almost all serial interfaces)
and of course the old SCSI-2 commands and more.
-Low Voltage Differential Parallel interface
-CD-R command set and algorithms

Future(after 1996): SCSI-3 becomes official
SCSI becomes a more network-like environment where devices can be
physically distributed and shared more easily.

====
Question: Can I access SASI drive with SCSI controller?
Answer From: Gary Field(gfield@grcelect.ultranet.com)
====

Well, the answer is a definite maybe, but very unlikely. Old low performance
SCSI adapters and drivers that use only a minimal subset of the SCSI
commands may work with SASI devices that happen to support the INQUIRY
command. Newer adapters and drivers expect to be able to use messages
and will get very upset with a SASI device that doesn't understand them.

In reality, there is no practical reason to do this. Any SASI device is
so obsolete that is has no real value in a system being used in 1990 or later.

====
Question: How should I lay out my SCSI bus? What should I avoid?
Question: Where do I put the terminators?
Question: Where should the adapter card be placed?
Answers From: Nick Kralevich <nickkral@cory.eecs.berkeley.edu>
edited by Gary Field (gfield@grcelect.ultranet.com)

====

One confusing thing about SCSI is what the SCSI bus is supposed to look like, and how devices should be placed on the bus.

The SCSI bus MUST run continuously from one device to another, like this:

```
  DEVICE A --------- DEVICE B --------- DEVICE C -------- DEVICE D
```

Where device A, B, C, and D can either be internal or external devices.

The devices on the SCSI bus should have at least 4 to 6 inches of cable between devices. This is to satisfy the SCSI-2 requirement that "stubs" be placed at least .1 meters apart. Some devices that have a lot of internal wiring between the connector and the SCSI chip can look like a "stub" or bus discontinuity. The reason for all these requirements is that a SCSI bus is really 18 "transmission lines" in the wave theory sense. A pulse propagating along it will "reflect" from any part of the transmission that is different from the rest of it. These relections add and subtract in odd combinations and cause the original pulse to be distorted and corrupted. The terminators "absorb" the energy from the pulses and prevent relections from the ends of the bus. They do this because they (hopefully) have the same impedance as the rest of the transmission line.

The SCSI bus must not have any "Y" shape cabling. For example, setting up a cable that looks like this is NOT allowed:

```
             DEVICE B
                  \
                   \
                    \
                     >------------- DEVICE C ----------- DEVICE D
                    /
                  /
                /
            DEVICE A
```

Where do I put the terminators?

Termination must be present at two and ONLY two positions on the SCSI bus, at the beginning of the SCSI bus, and at the end of the SCSI bus. There MUST be no more than two, and no less than two, terminators on the bus.

Termination must occur within 4 inches (.1 meter) of the ends of the SCSI bus.

The following ARE acceptable:

```
     +------------+----------+-----------+-----------+---------+
     |            |          |           |           |         |
  DEVICE A     Unconnected Unconnected Unconnected DEVICE B   DEVICE C
 Terminated                                              (adapter -Terminated)

     +------------+----------+-----------+-----------+---------+
     |            |          |           |           |         |
  DEVICE A  Unconnected  DEVICE B  Unconnected  Unconnected  DEVICE C
 Terminated              (adapter)                           Terminated
```

```
     +------------+----------+-----------+-----------+---------+
     |            |          |           |           |         |
  Terminated     DEVICE A  DEVICE B  Unconnected  Unconnected  DEVICE C
                 (adapter)                                     Terminated
```

The following ARE NOT allowed:

```
     +------------+----------+-----------+-----------+---------+
     |            |          |           |           |         |
  DEVICE A       DEVICE B   DEVICE C    Unconnected Unconnected Unconnected
 Terminated      (adapter)  Terminated

     +------------+----------+-----------+-----------+---------+
     |            |          |           |           |         |
 Unconnected     DEVICE A     DEVICE B  DEVICE C    Unconnected Unconnected
                Terminated    (adapter) Terminated
```

Where Should I place the SCSI adapter on the SCSI bus?

The placement of the SCSI adapter card can be on the end, at the beginning, or somewhere in the middle of the SCSI bus.
Quite frankly, placement of the controller card isn't special.
The adapter card is just another device on the SCSI bus.
As long as the rules above and in other sections of this FAQ are followed, there should be no problem placing the adapter card anywhere on the SCSI bus.

However, if you place the adapter card somewhere in the middle of the SCSI bus, you must be sure to disable termination on the adapter card. As noted previously, a SCSI device is only allowed to have terminations if it's at the end of the bus. Only two terminators are allowed to terminate the SCSI bus, one at each end.

One last note: It doesn't make any difference where each SCSI ID is placed along the bus. It only matters that no two devices have the same ID. Don't forget that the adapter has an ID too. (Usually ID 7).

====
QUESTION: What are the pros and cons regarding SCSI vs IDE/ATA ?
ANSWER From: Gary Field (gfield@grcelect.ultranet.com)
====

Pros of IDE/ATA:

        Inexpensive due to high volume of production
        Supported directly by system BIOS in most cases
        Less overhead per command

Cons of IDE/ATA:

        Very limited device attachment (two drives including CDROMs)
        Only supports disk, CDROM (and limited support for tape)
        Single threaded (commands do not overlap even with a second drive)
        CPU is tied up transferring all data
        IDE/ATA and ATAPI evolved as one kludge on top of another
          (so compatibility is not always good)
        Cannot handle scatter/gather operations well

Pros of SCSI:

        Flexible device attachment (up to 7 or 15 devices per SCSI bus)
        Support for almost any peripheral type (disk, tape, CDROM, scanner etc)
        All commands can overlap with commands on other devices
        Usually uses DMA to transfer data (which frees CPU for other tasks)
        Interface and protocol is carefully specified by ANSI

Largest, highest performance devices are available in SCSI before IDE
Most adapters can do scatter/gather DMA which is a necessity in virtual memory systems (Like Unix, NT) (Win 95 ?)

Cons of SCSI:
Generally more expensive than IDE/ATA
Slightly more complicated to install than IDE/ATA

Now that I've said that, here's an article to show that there's more than one opinion on this subject:

From: Ed Schernau <mithrandir@ids.net>
Subject: FYI: EIDE and DMA/Scatter-Gather

The Western Digital Caviar EIDE drive that came in what is now the file server in our office came with a Win3.x 32 BDA driver which allowed the user to select DMA type (B or F) and to implement scatter-gather.

Also, the Intel Triton chipset implements 2 EIDE controllers, and I know that at least the 1 on the PCI bus supports bus-mastering, as well as DMA. However, PIO transfers can be faster, the infamous Mode 4 can in theory, do 16.6 MB/sec and I've heard of a Mode 5 which can do 22 MB/sec.
Which [PIO] is only a benefit in single-tasking systems like DOS or Win3.x.

Sounds like Intel is trying to make EIDE into SCSI, eh?

====
Should I spend the extra money on SCSI or just get IDE?
ANSWER From: Gary Field (gfield@grcelect.ultranet.com)
====
For home users this is a difficult question to answer in general.
It totally depends on how you use your system, what operating system is installed, and whether you will add more I/O devices in the future.
For server systems in a corporate environment the only sensible answer is to go with SCSI peripherals.
IDE/EIDE is single threaded by nature. The current command must complete before additional commands can start. With most IDE adapters the processor must be involved in reading/writing the data from/to memory. Another drawback is that only two drives can be attached. In a single drive single-tasking system IDE will probably be slightly faster and is definitely less expensive.
When you start talking about multi-tasking operating systems (like Win95, WinNT, Unix, OS/2 and Netware) SCSI is now a big advantage. As disk drives get bigger, backup devices are becoming even more important. In my opinion floppy tapes just aren't satisfactory. They're too slow, too unreliable, non-portable(media exchange wise not physically), and have low storage capacities. SCSI tape drives are more expensive, but have none of these problems.
SCSI devices share the bus bandwidth efficiently by allowing one device to transfer data while another is seeking or rewinding its media.
Early SCSI implimentations had some compatibility problems but these days SCSI is simpler to install than EIDE.
Each user needs to make this choice individually, but if you don't consider all the issues, you can find yourself needing to re-vamp all your I/O to add a device later on. Before you decide to go with IDE, ask yourself if you will ever want to add a CDROM, CD-R, scanner, or tape drive or need more than two hard disk drives.

Here's a discussion that shows some of the advantages of SCSI in more detail:
from: Greg Smith (GREGS@lss-chq.mhs.compuserve.com)

Under DOS (and DOS/win3.1), there is very little useful work the host can do while waiting for a disk operation to complete. So handing off some work from a 66 MHz 486 to, say, an 8 MHz Z80 (on the controller) does result in a performance loss. Under EVERY other OS worth discussing (Unix, Netware, NT, OS/2, Win95 etc) the processor can go off and do something else while the access is in progress, so the work done by the other CPU can result in a performance increase. In such systems, due to virtual memory, a 64K byte 'contiguous' read requested by a process may be spread to 16 separate physical pages. A good SCSI controller, given a single request, can perform this 'scatter/gather' operation autonomously. ATA requires significant interrupt service overhead from the host to handle this.

Another big issue: ATA does not allow more than one I/O request to be outstanding on a single cable, even to different drives. SCSI allows multiple I/O requests to be outstanding, and they may be completed out of order. For instance, process 'A' needs to read a block. The request is sent to the drive, the disk head starts to move, and process 'A' blocks waiting for it. Then, process 'B' is allowed to run; it aslo reads a block from the disk. Process B's block may be sitting in a RAM cache on the SCSI controller, or on the drive itself. Or the block may be closer to the head than process A's block, or on a different drive on the same cable. SCSI allows process B's request to be completed ahead of process A's, which means that process B can be running sooner, so that the most expensive chip - the system CPU - tends to spend less time twiddling its thumbs. Under ATA, the process B request cannot even be sent to the drive until the process A request is complete. These SCSI capabilities are very valuable in a true multi-tasking environment, especialy important in a busy file server, and useless under DOS, which cannot take advantage of them.

I tend to hear from people, 'Well, I never use multitasking' because they never actively run two programs at once - all but one are 'just sitting there'. Consider what happens though, when you minimize a window which uncovers parts of four other application windows. Each of those applications is sent a message telling it to update part of its window; under win95, they will all run concurrently to perform the update. If they need to access disk (usually because of virtual memory) the smoothness of the update can depend a lot on the disk system's ability to respond to multiple independent read requests and finish them all as quickly as possible; SCSI is better at this.

So, yes, ATA is faster under DOS; but SCSI provides advantages which are inaccessible to DOS. They will benefit Win95 however. The cost of intelligent, fast SCSI controllers and drives should decrease as people discover these advantages and start buying them.
I should add that many of SCSI's advantages are NOT

available with some of the simpler SCSI controllers
which were targeted only to the DOS market or part of
cheap CDROM add-on kits.

Furthermore, SCSI allows far greater flexibility of
interconnect. I concede that for the mass market,
which likes to buy pre-configured machines, this
is but a small advantage.

====
QUESTION: Is it possible for two computers to access the same SCSI disks?
ANSWER From: burke@seachg.uucp (Michael Burke)
====

Yes, two (or more) systems can be on the same scsi bus as scsi disk and
tape drives. As long as the scsi requirements are met - cable lengths,
termination and type - the devices can share the scsi bus.
[Editor(GF): Each host adapter needs to have a unique ID just as the devices
do. Some adapters don't let you set this.]

The question should be - Are there any O/S' that will allow the sharing of
file systems? It would not make sense for two hosts to go about treating
shared disks as if they each owned the device. Data would be destroyed pretty
quickly.

On the issue of tape devices, however, O/S' tend to give exclusive usage
to an application. In this way, tape drives can be shared much more easily.
[Editor(GF): CDROM drives can also be shared pretty easily]

Disks can be best shared by having two (or more) partitions on a disk. Each
host "owning" its own file system.
[Editor(GF): You also need to watch out for host adapters that reset the bus
when booting. Some adapters let you control this.]

[Additional editorial comment(GF):
The above discussion refers primarily to PCs. There are high end
systems that do allow sharing SCSI devices. Usually, this is to allow
fault tolerance. Two systems are connected to the same set of SCSI storage
devices and when one of them fails, the other takes control. AIX with HACMP,
Digital Unix, and Digital VMS are examples of systems that allow this.
- Thanks to Cees de Groot for suggesting this addition.]

====
QUESTION: Is it possible for two computers to access the same SCSI tape?
ANSWER From: Gary Field (gfield@grcelect.ultranet.com)
====

Yes, this is not usually as problematic as sharing disks as long as the
operator is sensible about what is attempted.
Some things you need to watch out for:

- Both host's device drivers must use RESERVE/RELEASE commands to lock access.
  This locks the drive for access by only one system, the conflicting host
  gets BUSY status until the currently accessing host sends a RELEASE cmd.

- The adapter on both hosts have unique IDs.

- Good and common grounding of both systems and the devices.

- SCSI length limits are not violated.

o Make sure both hosts select the same data transfer mode (synch or asynch).

o Both hosts can be told which disks and other devices to access and not to attempt to access the ones owned by the other host.

====
QUESTION: What is the problem with the Adaptec 1542C and external cables?
ANSWER From: Scot Stelter, Adaptec (Product Manager for the AHA-1540)
====

Several articles lately have cited the importance of SCSI-2-compliant cables when cabling SCSI bus subsystems. Perhaps the most accurate and technically detailed one was published in Computer Technology Review in March (Volume XIII, No. 3. PP. 6). In short, it explains the double-clocking mechanism that can occur due to cables whose impedance falls below the 90-Ohm SCSI-2 spec. Steep edge speeds on the REQ and ACK lines of the SCSI bus exacerbate the problem, but non-compliant cables are the root cause. Both LAN TIMES in the US (5/24/93, page 115) and CT Magazine in Germany (7/93, page 18) cite this cable problem.

In an extensive survey of cables available in the US and Europe, we found that more than half of the cables available have single-ended impedances in the 65 to 80 Ohm range -- below the 90 to 132 Ohms specified in the SCSI-2 spec. It seems that some (not all) cable vendors do not understand the specification, describing their cables as SCSI-2 compliant when they are not. A common misconception is that SCSI-2 means a high-density connector. In fact, there are several connector options. I have published a technical bulletin that summarizes the critical requirements (TB 001, April 1993). An artifact of its faster design left the AHA-1540C with faster edge-speeds than its predecessor, the AHA-1540B. As I have said, this can exacerbate the effect of bad cables. This explains why some users could get their AHA-1540B to work when an early AHA-1540C might not. Essentially, the 1540B was more forgiving than the early 1540Cs. Good cables fixed the problem, but unfortunately for the user, good cables are hard to find.

After surveying the cable market and many of our customers, we decided that bad cables were going to be here for a while, and we had to make the 1540C as forgiving as the 1540B was. At the end of April '93 we made a change to the AHA-1540C that involved using a passive filter to reduce the slew rate of the ACK line, the signal that the host adapter drives during normal data transfers. Extensive testing with many intentionally illegal configurations confirms that we succeeded. Prior to release, we tested the AHA-1540C with over 200 peripherals, systems and demanding software programs with no failures. Then, a second team retested the AHA-1540C across a wild combination of temperatures, humidities and other stresses. This testing gives me confidence that the AHA-1540 line continues to serve as the gold standard for SCSI compatibility.

====
QUESTION: What is the difference between the Adaptec 1542A and 1542B?
ANSWER From: fishman@panix.com (Harvey Fishman)
====

The AHA-1542A is obsolete and no longer supported by Adaptec. They stopped providing firmware upgrades at some level prior to the equivalence to the 3.10 level of the AHA-1542B firmware. I am not sure just where though. The present latest AHA-1542B firmware is version 3.20, and supports drives up to 8GB under MS-DOS.

====
QUESTION: What are the differences between the Adaptec 1542B and the 1542C?
ANSWER from: Terry Kennedy (terry@spcvxa.spc.edu)
====

The 1542C is an an updated model which replaces the 1542B. The 1542C features jumperless setup, having only 8 DIP switches. All other configuration options are set using the 1542C's built-in BIOS configuration utility. Configurable features not found on the 1542B are:

- Ability to enable/disable sync negotiation on a per-ID basis (the 1542B could only do it for all ID's on the SCSI bus)
- Ability to send "start unit" commands on a per-ID basis
- BIOS works with alternate I/O port settings on the adapter
- Ability to boot from ID's other than 0
- Software-selectable termination
- Software-selectable geometry translation
- Additional DMA speeds of 3.3 and 10 MB/sec

Additionally, the 1542C uses a Z80 CPU and 8Kb buffer instead of an 8085 and 2Kb buffer as on the 1542B.

====
QUESTION: What are the differences between the 1542C and the 1542CF?
ANSWER from: Terry Kennedy (terry@spcvxa.spc.edu)
====

The 1542CF includes all of the 1542C features, and adds "Fast" SCSI operation, providing SCSI data rates of up to 10MB/sec (compared with an upper limit of 5MB/sec on the 1542C). This is unrelated to the host DMA rate. It also has a software-configurable address for the floppy controller and a "self-healing" fuse for termination power.

====
QUESTION: Where can I get SCSICNTL.EXE and other Adaptec files?
ANSWER From: randy@psg.com (Randy Bush)
        and Timothy Hu timhu@ico.isc.com
====

ftp.psg.com:~/pub/adaptec/...

SCSICNTL.EXE.Z
adse.dd
adse.dd.readme
list
os2drv.zip
scsi_drv.Z
scsi_drv.readm
update.pkg.Z

"list" is a file that describes all the files in this directory.

You can get the ASPI specs from Adaptec's Bulletin Board (408)945-7727.

[Editor(GF): You can also get ASPI spec's from Adaptec's WWW server.]

====
QUESTION: What kinds of Optical Drives are available?
The previousanswer From: joungwoo@mensa.usc.edu (John Kim) has been replaced with an updated version.

ANSWER From: Psycho Bob <honge@creighton.edu>[Editor(GF)]
DATE: Sep 18, 1996
====
As magnetic recording approaches the current engineering limit, more and more attention is paid to optical storage solutions. Optical storage has good points going for it -- immunity to stray magnetic field, potential for higher storage capacity per unit area, and relatively low media cost.

Although CD-ROM and CD-R are also optical storage units, they are not rewritable -- that puts them out as either secondary storage or primary backup storage for most of us. There is an upcoming sub-format called CD-E ("E" for erasable) that is suppose to become available in late 1996, but I haven't seen much news or even definite rumors. With the advent of DVD, the CD-E may only be a temporary stepping stone to recordable DVDs.

Currently, the most popular magnetic storage format is magneto-optical (MO) format. It was the only popular rewritable optical storage disc technology before Panasonic's phase-change double-function (PD) format came out in 1995.

Magneto-Optical

As the name implies, MO uses both magnetic and optical technology to store data on the disc. The disc itself is rare earth metal substrate. When data is to be written, the particular spot is first heated by the laser to the Curie point, and the magnetic field is generated while the spot cools. By varying the magnetic field angle, the substrate is polarized in certain way that it will reflect the laser beam differently depending on the magnetic field angle when the particular spot was cooling down.

MO comes in many sizes and capacities. Consumers were first exposed to MO in Steve Jobs' NeXT computer in the mid-1980s. Although 5.25" had a slow start due to initial high cost, it has been evolving quite nicely. The more popular ISO capacities for 5.25" MO are 2.4GB/2.6GB, 1.2GB/1.3GB, and the 600MB/650MB. In 3.5" form, MO is available in 540MB/640MB, 230MB, and the 128MB. There are also some 12" MO, 14" MO, and other odd sizes in odd capacities. But they are limited to niche markets.

Sony MiniDisc-Data

Derived from the Mini-Disc (MD) audio format Sony introduced, MD-Data is to MD as CD-ROM is to digital audio compact disc (CD-DA). MD-Data (and digital audio MD) is based on the same magneto-optical technology, which explains the high-cost of the consumer MD audio units.

MD-Data is the smallest of the MO family. With 2.5" form factor, it can store 140MB of uncompressed data. Current MD-Data drives are rather slow at 150KB/sec sustained transfer rate, but Sharp is hoping to change that. Sharp will (hopefully) ship a 300KB/sec by the end of 1996, with a second generation of MD-Data available by sometime in 1997. The current schedule from Sharp indicates the second generation MD-Data will be able to store up to 700MB with 600KB/sec transfer rate.

The most important technical advancement MD-Data brought for MO in general is the one-pass recording. Prior to 5.25" 2.4GB/2.6GB MO and 3.5" 540MB/640MB MO, almost all MO used two passes to write data onto the disc

-- one pass to erase the whole track, and a second pass to write the updated data. MD's one pass recording, called light intensity modulation, direct over-write (LIM-DOW, ISO 14517) will be in almost all the future MO formats until another better technology comes along.

Just like CD, MD-Data comes in various flavors -- rewritable, write-once, and read-only cartridges. There is also a hybrid disc for MD and MD-Data that is part read-only, and part rewritable.

Panasonic phase-change double-function (PD)

In around mid-'95, Panasonic released a proprietary optical storage format called phase-change double-function (PD) drive. The PD uses substrate that will reflect the light differently when heated to different temperatures. Write-once-read-multiple (WORM) drives were actually the first phase-change formats, but PD is the first *reversible* (that is, re-writable) phase-change format. Current PD stores 650MB per PD cartridge.

Currently, PD's only advantage over its MO brethren is the PD drive's ability to read regular CD-DA and CD-ROMs. The PD rewritable cartridge is not usable in regular CD-ROM drives.

WORM and CD-R

Both write-once-read-multiple (WORM) and compact disc recordable (CD-R) are both write-once formats -- once you have written the data to the disc, the data cannot be changed. Put another way, the disc media can only be used once. For long term archival of data that need not be changed, it makes sense -- as CD-R media price is unbeatable [As of mid 1996, 650 MB CD-R media sells for $6 to $8 each or about 1 cent per MB!] . Current CD-R offers maximum of 650MB per disc.

WORM was the first popular format for optical storage, before being eclipsed by MO. WORM is still used by big companies and the government for archival purposes since it has the characteristic of not being able to be altered wihout damaging the media (good audit trail).
The new WORM formats being introduced are tending to be more proprietary. There is rarely any interchangability between different vendor's drives and media.

During the WORM to MO transition, a curious format called continuous composite write-once (CCW) appeared. CCW cartridges function as WORM cartridges, writable using the installed base of WORM drives. But put it into MO drive, CCW cartridges becomes rewritable. Simply put, CCW is MO in WORM's clothing. Many of today's 5.25" MO drives still have the capability to read CCW cartridges.

The future

Almost all the formats mentioned above have future plans -- usually an "improved version" with faster and more storage capacity. The 5.25" MO camp is shooting for the 4.8GB/5.2GB range, with faster sustained transfer rate in writing data. 3.5" may double their 650MB soon by using both sides of the disc. PD may also double the storage space by using both sides of the disc. But currently it's doubtful as DVD has pretty much been finalized. It'll be interesting to see how Panasonic will interpret the PD in the DVD marketplace (DVD-PD?). DVD-RAM is rumored to use phase-change technology.

The same goes for CD-E, the latecomer of the bunch. If the CD-E is truly playable in ordinary CD-ROM (and audio CD player), it'll probably become the optical storage standard in all but the high-capacity, high-end/server market.

format	size	capacity	bytes per sector	sides used	capacity per side	standard
MO 1p	2.5"	140MB	2048/2336	single	140MB	Sony MD-Data
MO 2p	3.5"	128MB	512	single	128MB	ISO/IEC 10090 ECMA 154
MO 2p	3.5"	230MB	512	single	230MB	ISO/IEC 13963 ECMA 201
MO 1p	3.5"	540MB	512	single	540MB	DIS(ISO/IEC) 15041
		640MB	2048	single	640MB	
MO 2p	5.25"	600MB	512	dual	296MB	ISO/IEC 10089
		650MB	1024	dual	322MB	ANSI X3.2121-1992
MO 2p	5.25"	1GB	512	dual	463MB	ISO 13481
		1GB	1024	dual	510MB	
MO 2p	5.25"	1.2GB	512	dual	595MB	ISO/IEC 13549
		1.3GB	1024	dual	650MB	ECMA 184
MO 1p	5.25"	2.4GB	512	dual	2.298GB	DIS(ISO/IEC) 14517
		2.6GB	1024	dual	1.3GB	
MO 2p	5.25"	1.5GB	4096	dual	750MB	Panasonic
MO 1p	5.25"	4.6GB	1024	dual	2.3GB	Pinnacle Micro "Apex"
MO	12"	8GB				Nikon
MO	12"	3.2GB				Sony
MO	14"	6.8GB	1024	dual	3.4GB	Kodak System 2000
		10.2GB	1024	dual	5.1GB	
		14.8GB	1024	dual	7.4GB	
WORM	5.25"	2.6GB				DIS(ISO/IEC) 15486
WORM	5.25"	650MB		single	650MB	ISO/IEC 9171 Format A
WORM	5.25"	470MB				Panasonic
		940MB				
		1.4GB				
WORM	12"	15GB				Sony
PD 1p	5.25"	650MB	4096	single	650MB	Panasonic PD
CD-R	5.25"	550MB	2048	single	553MB	
		650MB	2048	single	650MB	
CD-E	5.25"	650MB	pending...			

*technology: 1p -- one-pass write
2p -- two-pass write

Standards for storage are set by many organizations. International Standards Organization (ISO), European Computer Manufacturers Association (ECMA), Deutsche Institut fur Normung (DIN), Japanese Industrial Standards Committee (JISC), and American National Standards Institute (ANSI) set the main optical disc storage standards. The ISO standards take precedence over all other standards.

In the above table, the heading defines one standard -- e.g. 5.25" MO 1.2GB/1.3GB has both ISO 13549 and ECMA 184 listed for it. IT IS NOT THAT 1.2GB FOLLOWS ISO 13549 AND 1.3GB FOLLOWS ECMA 184.

Of CD standards...

Funny as it seems, CD is actually considered as proprietary a format made by Sony and Phillips. The physical format for derivatives like CD-ROM and CD-R are "written in mutual agreement" in form of Red Book, Yellow Book, Orange Book, etc.

Of bytes/sector and usability...

As many of you might notice (especially on 5.25" MOs), there are different sized sectors. Many O/Ses assume one sector to contain 512 bytes. If you buy any of the media that use different than 512 byte/sector, you will need a software driver of some sort to use the media.

In optical media, the sectors are "hard sectored" at factory -- in other words, you cannot change the number of sectors by reformatting (low-level formatting) them. Take the 5.25" 1.2GB/1.3GB MO for example again. The 1.3GB media is sectored at 1024 bytes per sector. So the 1.3GB media has total of 637,041 sectors (per side) on it. If you do not use a software driver and your operating system does not properly recognize it, the 1.3GB media will become a 650MB cartridge (~325MB per side)!!

The safest bet is to use the 512 bytes/sector media. That should make the drive and media usable on most operating systems.

Addendum: (11/15/96)
Sony and Phillips have just announed finalization of compact disc re-writable (CD-RW), together with HP, Matsushita, etc. Long story short, the CD-RW uses phase-change media -- same as Panasonic proprietary PD format. Not only that, it also stores 650MB like PD. And also like the PD, the CD-RW media cannot be read in regular CD and CD-ROM drives (surprise!)!!

So, the good news is that CD-RW is here. The bad news is that it's as proprietary as Panasonic's PD in compatibility with current installed base of CD and CD-ROM players.

====
QUESTION: Where can I get various SCSI documentation?
====

Thanks to John Lohmeyer of Symbios Logic, a number of SCSI related files are available for anonymous ftp.

The archive contains a large amount of data relating to SCSI, and ESDI as well as SCSI-2, IPI, and Fiber Channel, as well as the last revision of the SCSI-1 and SCSI-2 standards before they went into publication by ANSI.

This information server is maintained by Symbios Logic (formerly NCR Corp., formerly AT&T Global Information Solutions) in the hope of returning some value to the Internet community. It contains information about commercial

products, and also about computing-related topics in which Symbios Logic
as a company, or individuals therein, have interest and expertise.
The information is accessible from several sources:
SCSI BBS: (719) 574-0424
anonymous ftp to ftp.symbios.com
WWW: http://www.symbios.com/x3t10

====
QUESTION: How can I find out about the emerging SCSI standards?
ANSWER From: Milton Scritsmier (milton@arraytech.com)
====

The X3T10 committee has opened up a WWW site. It has an overview of SCSI-3, as well as pointers to the WWW sites for the three serial interfaces (FC, SSA, and P1394), and a pointer to an online copy of a proposed SCSI-2 spec. Here is the original announcement:

Subject: New X3T10 Home Page
Date: Thu, 31 Aug 95 14:07:00 MDT

With a LOT of help from Carey Harrington (Thank you!), X3T10 now has a World Wide Web home page. If you have a web browser, you may want to check out:

   http://www.symbios.com/x3t10

John Lohmeyer, Chair X3T10 Technical Committee

ANSWER #2 From: Gary Bartlett (garyb@abekas.com)
A draft version of the SCSI-2 spec is in HTML form on the WWW at:
http://abekas.com:8080/SCSI2/

ANSWER #3 From: Gary Watson (trimm@netcom.com)

Small Form Factor (SFF) Committee documents are available by FaxAccess at:
(408) 741-1600 You will be asked to order documents by number.
For example: to get information on the Single Connector Attach spec.
The SCA-1 spec. is document #8015
The SCA-2 spec. is document #8046
document #8000 is and index to the other documents.

This FaxAccess service is available to all, but please keep in mind that unless you have engineering-level understanding of peripheral interfaces, you _will_not_ be able to understand any of it and you are wasting your own time and the bandwidth of these resources. If you are trying to learn more about SCSI, you are better off reading the magazine articles and books listed elsewhere in this FAQ.

The SCSI, SFF, SSA, and Fibre Channel reflectors:
A list of these is available on the Symbios WWW site.

"The SCSI, SFF, SSA, and Fibre Channel reflectors are for review and commentary on the respective specifications, not for asking questions about the interfaces (unless related to a specific ambiguity in a specification) nor for recruiting nor for technical support nor any purpose other than what is stated. The reflectors _are_ available for public review and commentary as required by ANSI and ISO."

Any spec on the reflectors or on
the bbs or on the ftp sites are **proposed** or **preliminary**

and are often subject to major substantive changes during the
committee process. Actual, released, final specs are *only*
available from Global Engineering Documents.

====
QUESTION: Where can I get official ANSI SCSI documents?
ANSWER #1 From: kev@hpcpbla.bri.hp.com (Kevin Jones)
         and jmatrow@donald.WichitaKS.NCR.COM (John Matrow)
====

  The SCSI specification: Available from:

      ANSI
      11 West 42nd St. - 13th floor
      New York, NY 10036
      Sales Dept. (212) 642-4900

        OR

      Global Engineering Documents
      15 Inverness Way East
      Englewood Co 80112-5704
      (800) 854-7179 or (303) 792-2181
      Int'l Sales Fax: (303) 397-2740

        SCSI-1: X3.131-1986
        SCSI-2: X3.131-199x
        SCSI-3 X3T9.2/91-010R4 Working Draft

====
QUESTION: What SCSI books and tutorials are available?
ANSWER From: Gary Field (gfield@grcelect.ultranet.com)

IN-DEPTH EXPLORATION OF SCSI can be obtained from
Solution Technology, Attn: SCSI Publications, POB 104, Boulder Creek,
CA 95006, (408)338-4285, FAX (408)338-4374

THE SCSI ENCYCLOPEDIA and the SCSI BENCH REFERENCE can be obtained from
ENDL Publishing, 14426 Black Walnut Ct., Saratoga, CA 95090,
(408)867-6642, FAX (408)867-2115

SCSI: UNDERSTANDING THE SMALL COMPUTER SYSTEM INTERFACE was published
by Prentice-Hall, ISBN 0-13-796855-8 (Seems to be out of print)

A neat little book called "Basics of SCSI" second edition, was sent to me
free of charge by Ancot Corporation, Menlo Park, CA (415) 322-5322.
It gives a simplified description of how most aspects of the SCSI bus work
and includes some discussion of SCSI-2 issues.

A new book has been published by No Starch Press, Daly City, CA,
called "The book of SCSI - A guide for Adventurers" by Peter M. Ridge.
ISBN # 1-886411-02-6 List Price $34.95.

ANSWER #2 From: Runar Jorgensen (runar.jorgensen@fys.uio.no)

There was a two part article in Byte Magazine. The first part was in Feb 1990
issue, p. 267-274 and the second was in Mar 1990 issue, p. 291-298.
Another two part article appeared in Byte in May 1986 and June 1986.

====
QUESTION: Where can I get information on various disk drives and controllers?

ANSWER: ekrieger@quasar.xs4all.nl (Eric Krieger) (Updated Sep. 30, 1994)
====

Drive and Controller Guide, Version 4.3

THEREF(tm) is a comprehensive Directory of Hard Drives, Floppy Drives, Optical Drives, and Drive Controllers & Host Adapters. It is designed to help the novice and pro alike with integration problems and system setups.

Information is provided in two handy formats; Portrait mode, for those who prefer a normal book-binding type print format, and(or) do not have a printer with Landscape capability. And Landscape mode, for those who prefer a computer-printout type format.

For printing, a Laserjet is preferred, but not necessary, and setup info is provided. For viewing, LIST(tm) by Vernon Buerg, will provide an excellent result, and allow text searches for finding specific models.

By F. Robert Falbo

Due many reports about the unavailablity of this file/archive I made sure that the file does exist at the following site:

ftp.funet.fi

you should find the archive at:

/pub/doc/hardware/harddisks/theref43.tar.gz
/pub/doc/hardware/harddisks/theref43.readme

(In that directory-path there is also a sub-directory Seagate, where you also can find info/files about Seagate-drives).

Before you actually get this file, be sure to get/read the file /README.FILETYPES since it explains the used file-extension and which (de-)archiver should be used (and where to find/get them!).

Note: In the archive there are files containing Extended ASCII or ANSI characters (mostly used with IBM- and compatible PC's), so it may be a bit unreadable when reading it on non-PC systems, or without using a proper Characterset/Font!

TheRef is also available via WWW from:
http://theref.c3d.rl.af.mil

====
QUESTION: Where can I get technical information and jumper settings for HP drives ?
ANSWER From: Rodney Brown (RBrown@cocam.com.au)
Update From: Martin C Mueller (mcm@mathematik.uni-kl.de)
====

HP SCSI Storage Device Support Pages

http://www.hp.com/isgsupport/index.html

====
QUESTION: How can I contact Adaptec?
ANSWER From: jcaples@netcom.com (Jon D Caples)
====

```
        408 945-8600    Main number
        800 959 7274    tech support
        800 442 7274    orders, doc, new bios, etc.
        408 945-7727    BBS
```

Adaptec's general inquiry number, 800-959-7274, affords access to a FAX-based information retrieval system. In order to preserve the accuracy of this information, I won't go into details about how to use it (since Adaptec may change things without telling me :).

For those outside the CAN-US area, or local to Adaptec the direct FAX info number is (408) 957-7150.

There are three general topics as of this writing:

General Information
Sales Information
Technical Information

Give it a call and request the directory! As of this writing there are over 130 documents available. You need a touchtone phone and the fax number. You'll also be asked for an extension number to stamp on the FAX which will be used to identify the recipient.

[Editor(GF): As of July 1993 Adaptec bought Trantor.
Try (800) 872-6867 (TRA-NTOR)]

World Wide Web (WWW) URL:
http://www.adaptec.com

[(from: Andrew Lockhart (andrew@interact.manawatu.planet.co.nz)]
You can address Adaptec support by email. The address is support@adaptec.com. An auto-responder will bounce a message back acknowledging receipt of your email. This message will also detail other current forms of Adaptec Technical support. They promise a, no more than, 5 day turn-around. We have found the response brief, but satisfactory to our needs. We should add, we mention we are Dealers in our email".

====
QUESTION: What is the telephone number of Archive Corporation?
====

[Editor(GF)]
Archive was bought by Conner in 1993

====
QUESTION: How can I contact BusLogic /Bustek / Mylex ?
ANSWER From: Gary Field (gfield@grcelect.ultranet.com)
====

BusLogic Inc.
4151 Burton Drive
Santa Clara, CA 95054

```
Phone:  (800)707-7274
        (408)492-9090
        (408)970-1414 (Support)
BBS:    (408)492-1984
Contact:  Jerry Tennant (Sales)
```

Taylor Ellerbe (Support)

WWW: http://www.mylex.com/

====
QUESTION: How can I contact Corel?
ANSWER From: Gary Field (gfield@grcelect.ultranet.com)
====

Main Number: (800) 772-6735
Tech. Support: (613) 728-1010

ANSWER From: Gerrit Visser (gerrit@isgtec.com)
====
WWW: http://www.corel.ca/

ftp: ftp.corel.ca: /pub SCSI is under Multimedia

====
QUESTION: How can I contact Fujitsu?
ANSWER From: Ken Porter (72420.2436@compuserve.com)
====
Fujitsu FactsLine FAX Back service (408) 428-0456
A six page catalog of available documents can be ordered.

ANSWER From: Mike Henry (mhenry@intellistor.com)

A while back, Fujitsu created a product called
Fujitsu Knowledge System (FKS) (long available on Compuserve
(GO FUJITSU)). It is a Windows Help File (.HLP) listing
of many Fujitsu disk, tape, and optical products.

It includes drive switch/jumper settings and meanings
(lot of posts requesting this info).

It is available via anonymous ftp
from ftp.intellistor.com
in the /pub/fks directory
filename: fks.exe

It is self-extracting and mostly self-documenting.

====
QUESTION: How can I contact Quantum?
ANSWER From: kmartine@qntm.com (Kevin Martinez)
====

Quantum Corporation
500 McCarthy Blvd.
Milpitas, CA
95035

Technical Support Telephone Numbers:

800 826-8022	Main Technical Support Number
408 894-3282	Technical Support Fax
408 894-3214	Technical Support BBS V.32 8N1
408 434-9262	Technical Support for Plus Development Products
408 894-4000	Main Quantum Phone number

```
800 4DISKFAX   FAX on demand (From Thanh Ma tma@encore.com)

WWW:            http://www.quantum.com

====
QUESTION: How can I contact Seagate?
ANSWER From: landis@sugs.tware.com (Hale Landis)
====

Here are the numbers for Seagate's Technical Support.

SeaBOARD - Bulletin Board System available 24 hours.  Use 8 data
           bits, no parity, 1 stop bit (8-N-1).

   USA/Canada  408-438-8771    9600 baud*
   England     44-62-847-8011  9600 baud*
   Germany     49-89-140-9331  2400 baud*
   Singapore   65-292-6973     9600 baud*
   Australia   61-2-756-2359   9600 baud*

   * - Maximum baud rate supported.

SeaFAX 408-438-2620

   Use a touch-tone phone to have information returned to you via
   FAX.  Available 24 hours.

Technical Support Fax 408-438-8137

   FAX your questions or comments 24 hours.  Responses are sent
   between 8:00AM and 5:00PM PST Monday through Friday.

SeaFONE 408-438-8222

   Provides recorded information 24 hours or talk to a technical
   specialist between 8:00AM to 5:00PM PST Monday through Friday.

SeaTDD 408-438-5382

   Using a Telecommunications Device for the Deaf, you can send
   questions or comments 24 hours or have a dialog with a
   technical support specialist between 8:00AM and 5:00PM PST
   Monday through Friday.

WWW:    http://www.seagate.com

====
QUESTION: How can I contact Conner Peripherals?
====

Conner Peripherals was bought by Seagate

====
QUESTION: How can I contact Maxtor?
ANSWER From: David G North (D_North@tditx.com)
====

Main Number: (800) 262-9867     (Has FAXback feature for drive info etc)
ftp site: ftp.maxtor.com (New!)

ANSWER From: Eric Van Buren (vanburen%flovax.dnet@rocdec.roc.wayne.edu)
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====
WWW: http://www.maxtor.com/

====
QUESTION: How can I contact NCR?
====

NCR Microelectronics division was bought by AT&T and then by Symbios Logic.

See "How can I contact Symbios Logic"


====
QUESTION: How can I contact Philips?
ANSWER From: S. C. Mentzer (smentzer@anes.hmc.psu.edu)
====

Philips Consumer Electronics Co.
One Philips Drive
Knoxville, TN 37914-1810
(615) 521-4316
(615) 521-4891 (FAX)

[Editor(GF)]
WWW: http://www.philips.com/

====
QUESTION: How can I contact Symbios Logic?
Answer From: Symbios Logic
====

The latest Symbios Logic PCI-SCSI drivers and documentation are available on
the Symbios Logic BBS at (719) 573-3562 or the FTP.SYMBIOS.COM anonymous
FTP site. The NCRINFO.NCR.COM site still contains standards and
other information.

For literature on any Symbios Logic product please contact:

Phone: (800) 334-5454
               (719) 536-3300
Fax:      (719) 536-3301
Internet: literature@symbios.com

Technical Support:

Hotline: (719) 573-3016
Internet: ncr.chips@FtCollinsCO.NCR.COM
WWW:      http://www.symbios.com/

====
QUESTION: How can I contact UltraStor? (Out of business)
Answer From: Ultrastor
====

     UltraStor Corporation
     13766 Alton Parkway suite 144
     Irvine, CA 92718

     General        (714) 581-4100
     Tech. Support  (714) 581-4016
     FAX            (714) 581-4102
```

```
     BBS            (714) 581-4125

     email:     ultrastor@primenet.com
     finger:    ustor@primenet.com
     ftp:       ftp.primenet.com:users/u/ustor
```

====
Answer From: Ben Mehling (bmehling@uci.edu)
====
I am setting up a "unauthorized" UltraStor site for the orphaned customers and cards still out there.

> I do not think the above numbers are good anymore. The 4100 line will get you Power I/O (an unrelated Adaptec holding) and the 4016 line may get you a dead-end answering service. The company is no longer active (as far as I know). The primenet account is alive, but again not active. These links are to the "Unauthorized" UltraStor site. This site is in no way affiliated with UltraStor or its holding companies. It is a free "mirror" site for distribution of drivers and information. (hint: we are trying to help out, not provide tech support.) Try:
>
> UltraStor@kuci.uci.edu (unauthorized).
> www.UltraStor (unauthorized).
> ftp.UltraStor (unauthorized).

The above three addresses are hypertext linked to these addresses:

The web site address is: www.kuci.uci.edu/~ustor
The FTP site address is: falco.kuci.uci.edu/users/ustor
The mail/finger address is ultrastor@kuci.uci.edu / ustor@falco.kuci.uci.edu

The current maintainers are:

Ben Mehling (bmehling@uci.edu)
Phil Colline (pcolline@falco.kuci.uci.edu)

====
QUESTION: How can I contact Tecmar Technologies (formerly Wangtek, WangDAT, Sytron, and Rexon)?
ANSWER FROM: from: Jay Long - (jayl@mfltd.co.uk) and
Peter Dyballa (pete@riese.thi.informatik.uni-frankfurt.de)
====

Tecmar Technologies, Inc.
1900 Pike Rd., Bldg. E
Longmont, CO USA
phone: (303) 682-3700
       (303) 776-7706
FAX: (303)776-1085
faxback: (800) 4BACKUP

WWW: http://www.tecmar.com/

European Office
Unit 15 Suttons Business Park
Suttons Park Avenue
Earley, Reading, UK RG6 1AZ
(44) 1189-660063
(44) 1189-660065 FAX

```
Singapore Office
Blk. 35 Marsiling Industrial Estate Road 3 #05-01/ 06
Singapore 739257
(65) 269-2228
(65) 360-0888 fax

====
QUESTION: How can I contact Western Digital?
ANSWER From: FILIPG@PARANOIA.COM
====
Address:
           Western Digital Corporation
           8105 Irvine Center Drive
           Irvine, CA  USA   92718

Online Services:
           Tech Support BBS  714-753-1234   (up to 28.8 KBS)
           Internet          www.wdc.com
           FTP               ftp.wdc.com
           AOL  (keyword)    WDC or Western Digital
           MSN  (go word)    WDC

====
QUESTION: How can I contact DPT (Distributed Processing Technology)?
ANSWER: From: Gary Field (gfield@grcelect.ultranet.com)
====

voice: (407) 830-5522
FAX:   (407) 260-6690

[Editor(GF)]
WWW: http://www.dpt.com/

====
QUESTION: How can I contact Micropolis?
ANSWER: From: Richard Ravich (Richard_Ravich@microp.com)
====

Tech Support: (818) 709-3325
email: Richard_Ravich@microp.com
WWW:   http://www.micropolis.com/

====
QUESTION: How can I contact Legacy Storage Systems ?
ANSWER: From: Gregory Smith (GREGS@lss-chq.mhs.compuserve.com)
====

General:                          (905) 475-1077
Sales/Tech support/Service:       (905) 475-0550
U.S. Tech Support:                (800) 361-5685
Fax:                              (905) 475-1088

Mail:
      Legacy Storage Systems
      43 Riviera Drive
      Markham, ON Canada L3R 5J6

====
QUESTION: what is FAST SCSI?
ANSWER From: kev@hpcpbla.bri.hp.com (Kevin Jones)
====
```

There are 2 handshaking modes on the SCSI bus, used for transferring data: ASYNCHRONOUS and SYNCHRONOUS. ASYNCHRONOUS is a classic Req/Ack handshake. SYNCHRONOUS is "sort of" Req/Ack, only it allows you to issue multiple Req's before receiving Ack's. What this means in practice is that SYNCHRONOUS transfers are approx 3 times faster than ASYNCHRONOUS.

SCSI1 allowed asynchronous transfers at up to 1.5 Mbytes/Sec and synchronous transfers at up to 5.0 Mbytes/Sec.

SCSI2 had some of the timing margins "shaved" in order that faster handshaking could occur. The result is that asynchronous transfers can run at up to 3.0 Mbytes/Sec and synchronous transfers at up to 10.0 Mbytes/Sec.
The term "FAST" is generally applied to a SCSI device which can do syncrhonous transfers at speeds in excess of 5.0 Mbytes/Sec. This term can only be applied to SCSI2 devices since SCSI1 didn't have the timing margins that allow for FAST transfers.

====
QUESTION: SCSI terminators should measure 136 ohms?
ANSWER From: stevel@coos.dartmouth.edu (Steve Ligett)
====

Yes, that is what you should measure. Let's see how that is so. The terminator contains 18 220-ohm resistors from signals to termpower, and 18 330-ohm resistors from those signals to ground. I've drawn that below:

```
termpower--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
220 ohms-> R  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
signals -> o  o  o  o  o  o  o  o  o  o  o  o  o  o  o  o  o  o
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
330 ohms-> R  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
ground   --+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
```

When you measure from any one signal to termpower, you aren't measuring that resistor in isolation, you are measuring that resistor IN PARALLEL with the combination of the corresponding 330 ohm resistor plus 17 220+330 ohm resistor pairs in series. I've redrawn the schematic to make this easier to see:

```
termpower--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
           |  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R <- 220 ohms
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
           |  o  o  o  o  o  o  o  o  o  o  o  o  o  o  o  o  o
           |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
           |  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R  R <- 330 ohms
  220 ohms R  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
           |  +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+-- ground
           |  |
           |  R <-- 330 ohms
           |  /
signal ->  o-/

<our resistor><--------- other stuff that's in parallel ---------->
```

We're trying to measure that one resistor from a signal to termpower, but there's a ton of other stuff in parallel. The resistance of that "stuff" is 330 + 550/17 ohms (the 330 ohm resistor, in series with a parallel combination of 17 550 ohm resistors). The general formula for the equivalent of two resistances in parallel is r1*r2/(r1+r2). Whipping out my trusty spreadsheet, I find that the "stuff" has a resistance of about 362 ohms, and that in parallel with 220 ohms is about 137 ohms.

====
QUESTION: Can someone explain to me the difference between 'normal' scsi and differential scsi?
ANSWER From: ralf@wpi.WPI.EDU (Ralph Valentino)
====

"Normal" SCSI is also called "Single-ended" SCSI. For each signal that needs to be sent across the bus, there exists a wire to carry it. With differential SCSI, for each signal that needs to be sent across the bus, there exists a pair of wires to carry it. The first in this pair carries the same type of signal the single-ended SCSI carries. The second in this pair, however, carries its logical inversion. The receiver takes the difference of the pair (thus the name differential), which makes it less susceptible to noise and allows for greater cable length.

====
QUESTION: What are the pinouts for differential SCSI?
ANSWER From: ralf@wpi.WPI.EDU (Ralph Valentino)
====

Differential SCSI Connector Pinouts

SCSI SIGNAL	DD-50P	MINI MICRO	DD-50SA	SCSI SIGNAL	DD-50P	MINI MICRO	DD-50SA
-GND	2	26	34	(open)	1	1	1
-DB(0)	4	27	2	+DB(0)	3	2	18
-DB(1)	6	28	19	+DB(1)	5	3	35
-DB(2)	8	29	36	+DB(2)	7	4	3
-DB(3)	10	30	4	+DB(3)	9	5	20
-DB(4)	12	31	21	+DB(4)	11	6	37
-DB(5)	14	32	38	+DB(5)	13	7	5
-DB(6)	16	33	6	+DB(6)	15	8	22
-DB(7)	18	34	23	+DB(7)	17	9	39
-DB(P)	20	35	40	+DB(P)	19	10	7
GND	22	36	8	DIFSENS	21	11	24
GND	24	37	25	GND	23	12	41
TERMPWR	26	38	42	TERMPWR	25	13	9
GND	28	39	10	GND	27	14	26
-ATN	30	40	27	+ATN	29	15	43
GND	32	41	44	GND	31	16	11
-BSY	34	42	12	+BSY	33	17	28
-ACK	36	43	29	+ACK	35	18	45

-RST	38	44	46		+RST	37	19	13
-MSG	40	45	14		+MSG	39	20	30
-SEL	42	46	31		+SEL	41	21	47
-C/D	44	47	48		+C/D	43	22	15
-REQ	46	48	16		+REQ	45	23	32
-I/O	48	49	33		+I/O	47	24	49
GND	50	50	50		GND	49	25	17

Please note that I can only verify the DD-50P connector. The Mini Micro and DD-50SA pinout above is a pin for pin mapping from the SCSI pinout in the FAQ.

How to tell if you have a single ended or differential drive:

- Use an ohm meter to check the resistance between pins 21 & 22. On a single ended system, they should both be tied together and tied to GND. On the differential drive, they should be open or have a significant resistance between them. Note that most drives today are single ended so you usually only have to worry about this with old drives scavenged from other systems.

[Editor(GF): The preceeding comment about differential drives being old is not valid. Differential drives are less common than single-ended ones, because they are mainly used only where longer cable runs are necessary, and they are not generally used in PCs, but state of the art drives are available with differential interfaces. Generally only the higher performance drives have a differential option because of the added cost.]

====
QUESTION: Who manufactures SCSI extenders and Single-Ended to Differential converters ?
ANSWER From: Gary Field (gfield@grcelect.ultranet.com)
====

The following companies manufacture SCSI extenders and converters:

Ancot Corporation
115 Constitution Drive
Menlo Park, CA 94025
Tel: (415) 322-5322
Fax: (415) 322-0455
Email: sales@ancot.com
URL: http://www.ancot.com/

Apcon Inc.
17938 SW Boones Ferry Road
Portland, OR 97224
Phone: (503) 639-6700 Fax: (503) 639-6740
Email: info@apcon.com
URL: http://www.apcon.com/

Paralan Corporation
7875 Convoy Court, San Diego, CA 92111
Tel. (619) 560-7266 || Fax 619-560-8929
WWW: http://www.paralan.com/
email: scsi@paralan.com

Rancho Technology Inc.
10783 Bell Court-Rancho

Cucamonga-CA-91730
Phone: (909)987-3966; Fax: (909)989-2365;
E-Mail: scsi@rancho.com; BBS: (909)980-7699
URL: http://www.rancho.com/

====
QUESTION: What are the pinouts for SCSI connectors?
ANSWER From: snively@scsi.Eng.Sun.COM (Bob Snively)
[Edited and expanded by Gary Field (gfield@grcelect.ultranet.com)]
====

Originally dated May 23, 1990

The connector families described by the drawings have standard pin numberings which are described the same way by all vendors that I have encountered. The SCSI-2 specification identifies the standard numbering, using that convention. It happened to be documented by AMP, but all the vendors use the same convention.

The following diagrams have the outline drawings of connector sockets at the bottom. This is really for reference only, because the connector sockets and plugs are both specified as to their numbering and usually are labeled.

There are some minor problems in naming the microconnector conductor pairs, which I have corrected in the enclosed diagram. All the conductor pairs of the Mini-Micro (High Density) connector are in fact passed through on the cables. SCSI-2 defines the RSR (Reserved) lines as maybe ground or maybe open, but they are still passed through the cable. Most present standard SCSI devices will ground those lines.

-------------------- microSCSI to SCSI Diagram --------------------------

SCSI Connector Pinouts (single-ended)

SCSI SIGNAL	DD-50P	MINI MICRO	DD-50SA	SCSI SIGNAL	DD-50P	MINI MICRO	DD-50SA
-DB(0)	2	26	34	GND	1	1	1
-DB(1)	4	27	2	GND	3	2	18
-DB(2)	6	28	19	GND	5	3	35
-DB(3)	8	29	36	GND	7	4	3
-DB(4)	10	30	4	GND	9	5	20
-DB(5)	12	31	21	GND	11	6	37
-DB(6)	14	32	38	GND	13	7	5
-DB(7)	16	33	6	GND	15	8	22
-DB(P)	18	34	23	GND	17	9	39
GND	20	35	40	GND	19	10	7
GND	22	36	8	GND	21	11	24
RSR	24	37	25	RSR	23	12	41
TERMPWR	26	38	42	OPEN	25	13	9
RSR	28	39	10	RSR	27	14	26
GND	30	40	27	GND	29	15	43
-ATN	32	41	44	GND	31	16	11
GND	34	42	12	GND	33	17	28
BSY	36	43	29	GND	35	18	45
-ACK	38	44	46	GND	37	19	13
-RST	40	45	14	GND	39	20	30
-MSG	42	46	31	GND	41	21	47

-SEL	44	47	48		GND	43	22	15
-C/D	46	48	16		GND	45	23	32
-REQ	48	49	33		GND	47	24	49
-I/O	50	50	50		GND	49	25	17

* NC = NOT CONNECTED

CONNECTOR TYPES:

```
                                    DD-50SA
                          ___________________________
      DD-50P             |   --------------------    |          MINI-MICRO
    _______ _______      |17 \. . . . . . . . . ./1  |    ________________________
49| . . . . . . . |1     | 33 \. . . . . . . . ./18  |   |  __________________    |
50| . . . . . . . |2     |  50 \. . . . . . . ./ 34  |   | 1\ - - - - - - - - /25 |
   --------------        |      --------------       |   | 26\- - - - - - - -/50  |
                         -----------------------------   |     --------------     |
                                                          ------------------------
   ribbon cable          Old style Sun SCSI                   "SCSI-2"
      male                                                      male
```

```
 _____________________
(   1            25  )
 \  ++++++++++++++   /
  \ 26          50 /
    ---------------
```

"Centronics" 50 male (use pin numbers for MINI-MICRO)

(VIEWED FROM FACE OF CONNECTOR - USE VENDOR NUMBERING SYSTEM AS SPECIFIED)

16 bit Wide SCSI-3 "P" (Primary) Connector pinout (single-ended)

SCSI SIGNAL	HIGH DEN 68 PIN	SCSI SIGNAL	HIGH DEN 68 PIN
GND	1	-DB(12)	35
GND	2	-DB(13)	36
GND	3	-DB(14)	37
GND	4	-DB(15)	38
GND	5	-DB(P1)	39
GND	6	-DB(0)	40
GND	7	-DB(1)	41
GND	8	-DB(2)	42
GND	9	-DB(3)	43
GND	10	-DB(4)	44
GND	11	-DB(5)	45
GND	12	-DB(6)	46
GND	13	-DB(7)	47
GND	14	-DB(P)	48
GND	15	GND	49
GND	16	GND	50
TERMPWR	17	TERMPWR	51
TERMPWR	18	TERMPWR	52
RSRVD	19	RSRVD	53
GND	20	GND	54
GND	21	-ATN	55
GND	22	GND	56
GND	23	BSY	57
GND	24	-ACK	58
GND	25	-RST	59

```
|   GND    |   26    |        |  -MSG    |   60    |
|   GND    |   27    |        |  -SEL    |   61    |
|   GND    |   28    |        |  -C/D    |   62    |
|   GND    |   29    |        |  -REQ    |   63    |
|   GND    |   30    |        |  -I/O    |   64    |
|   GND    |   31    |        |  -DB(8)  |   65    |
|   GND    |   32    |        |  -DB(9)  |   66    |
|   GND    |   33    |        |  -DB(10) |   67    |
|   GND    |   34    |        |  -DB(11) |   68    |
-----------------        -----------------
   ____________________________
  |   _______________________   |
  | 1\ - - - - - - - - - - - /34 |
  | 35\- - - - - - - - - - -/68 |
  |    -------------------      |
   ----------------------------
         "WIDE SCSI-3 P"
             male
```

IBM's "Not really SCSI" connectors: [Editor(GF)]

Note that this connector is NON-COMPLIANT WITH ANY SCSI STANDARD!

60 pin Burndy connector as used on IBM RS/6000 systems:

Pin	Signal	Pin	Signal
1	Gnd	31	Gnd
2	-DB(0)	32	-ATN
3	Gnd	33	Gnd
4	-DB(1)	34	Gnd
5	Gnd	35	Gnd
6	-DB(2)	36	-BSY
7	Gnd	37	Gnd
8	-DB(3)	38	-ACK
9	Gnd	39	Gnd
10	-DB(4)	40	-RST
11	Gnd	41	Gnd
12	-DB(5)	42	-MSG
13	Gnd	43	Gnd
14	-DB(6)	44	-SEL
15	Gnd	45	Gnd
16	-DB(7)	46	-C/D
17	Gnd	47	Gnd
18	-DB(P)	48	-REQ
19	Gnd	49	Gnd
20	Gnd	50	-I/O
21	Gnd	51	Gnd
22	Gnd	52	Reserved
23	Gnd	53	Reserved
24	Gnd	54	Reserved
25	N/C	55	Reserved
26	TERMPWR	56	Reserved
27	Gnd	57	Reserved
28	Gnd	58	Reserved
29	Gnd	59	Reserved
30	Gnd	60	Reserved

====

ANSWER From: Gary Field (gfield@grcelect.ultranet.com)

Macintosh Plus SCSI Connector Pinouts

Note that this connector is NON COMPLIANT WITH ANY SCSI STANDARD!
The grounding is insufficient and does not allow for proper twisted-pair transmission line implementation. It is recommended that a short adapter cable be used to convert to the more common Centronics style 50 pin connection rather than extend the 25 pin connection any further than necessary.
The Macintosh Plus used a NCR 5380 SCSI chip controlled by the MC68000 processor.

SCSI SIGNAL	DB-25S
-DB(0)	8
-DB(1)	21
-DB(2)	22
-DB(3)	10
-DB(4)	23
-DB(5)	11
-DB(6)	12
-DB(7)	13
-DB(P)	20
GND	7,9,14
GND	16,18,24
-ATN	17
BSY	6
-ACK	5
-RST	4
-MSG	2
-SEL	19
-C/D	15
-REQ	1
-I/O	3

```
          DB-25S (female)
  _____________________________
13\ o o o o o o o o o o o o o /1
 25\ o o o o o o o o o o o o /14
    ------------------------
   View from rear of computer.
```

Pin 25 is NOT CONNECTED in the Mac Plus implementation. Newer Macs connect TERMPWR to pin 25, but are otherwise the same.

Future Domain 25 pin connector pinout

Used on TMC-830/845 and TMC-850/860/885.
Note:
Use the Macintosh pinout above for TMC-850M, TMC-1610M, TMC-1650/1670 or MCS-600

SCSI SIGNAL	DB-25S
-DB(0)	14
-DB(1)	2
-DB(2)	15
-DB(3)	3
-DB(4)	16
-DB(5)	4
-DB(6)	17
-DB(7)	5
-DB(P)	18
GND	1,6,8,13

```
          DB-25S (female)
  _____________________________
13\ o o o o o o o o o o o o o /1
 25\ o o o o o o o o o o o o /14
    ------------------------
   View from rear of computer.
```

```
|  GND   |13,19,25 |
| -ATN   |    20   |
|  BSY   |    23   |
| -ACK   |    22   |
| -RST   |    10   |
| -MSG   |    21   |
| -SEL   |     7   |
| -C/D   |    11   |
| -REQ   |    24   |
| -I/O   |    12   |
+------------------+
Pin 9 is NOT CONNECTED

--------------------  END of Part 1 -----------------------
--
--/* Gary Field - WA1GRC, Digital Equipment Corp., 110 Spit Brook Rd
     M/S ZKO3-3/T79, Nashua, NH 03062-2698, phone: (603) 881-2543
     email: gfield@zk3.dec.com   http://www.ultranet.com/~gfield TZ=EST5EDT
                          Press RESET to continue.                          */
```